REMARKS

Claims 1-12 are pending in the application. Claim 4 has been cancelled. Claims 1, 5, 7, 9, and 11 have been amended. Claims 13-17 have been added. The amendment is fully supported by the original disclosure. No new matter has been introduced. Reconsideration and allowance of claims 1-3 and 5-17 in view of the following remarks is respectfully requested.

The objection to the title of the invention:

The examiner objects to the title of the invention for being not descriptive. Accordingly, applicant has amended the title to be clearly indicative of the invention to which the claims are directed.

The objection to the oath/declaration:

The examiner objects for a lack of post office address anywhere in the application papers as required by 37 C.F.R. 1.33(a). Applicant believes that the Revocation of Power of Attorney and Appointment of New Power of Attorney filed on October 24, 2002, provides a complete post office address as required by 37 C.F.R. 1.33(a).

The rejection of claims 1-4 and 9-12 under 35 U.S.C. § 102(e):

Claims 1-4 and 9-12 stand rejected as anticipated by Maatuk (U.S. Patent No. 5,908,985).

Applicant disagrees with the examiner's conclusion and traverses the rejection for the following reasons. For prior art reference to anticipate under 35 U.S.C. § 102, each and every element of the claimed invention must be identically shown in the reference. Maatuk does not disclose the limitation in amended independent claim 1 reciting that the "sensor comprises a variable resistance means wherein the resistance … varies … said temperature signal being of a magnitude proportional to the magnitude of the resistance".

Maatuk only discloses "processing thermocouple voltage signals" (at column 10, lines 13-17; see also column 3, lines 15-17; and column 7, lines 26-31). Accordingly, amended independent claim 1 is not anticipated by Maatuk.

Further, applicant submits that claim 1 is not rendered obvious by Maatuk. Specifically, applicant cautions that any attempt to cure Maatuk of its above deficiencies in the 102 rejection will fail because Maatuk explicitly teaches away from using resistance sensors and/or resistance data, stating in part that "[t]his invention precludes the short comings inherent in liquid level devices employing resistive probes" (at column 1, lines 29-57). Due to this teaching away, there can be no cure for Maatuk's failure to teach or suggest all the claim limitations of independent claim 1. Accordingly, independent claim 1 is not rendered obvious by Maatuk.

Independent claims 11, 13, and 16 contain similar limitations to claim 1, reciting that the sensor be a resistance device of some sort. Accordingly, claims 11, 13 and 16 are not anticipated by nor obvious in view of Maatuk.

Claims 2, 3, 9, 10, and 15 depend from independent claim 1, and are likewise not anticipated or rendered obvious by Maatuk at least due to their depending on claim 1. Claim 12 depends from independent claim 11, therefore claim 12 is likewise not anticipated or rendered obvious by Maatuk at least due to its dependency on claim 11. Claim 14 depends from independent claim 13, therefore claim 14 is likewise not anticipated or rendered obvious by Maatuk at least due to its dependency on claim 13. Claim 17 depends from independent claim 16, therefore claim 16 is likewise not anticipated or rendered obvious by Maatuk at least due to its dependency on claim 16.

Allowable subject matter:

The examiner has objected to claims 5-8 as being dependent on rejected base claims, but allowable if rewritten in independent form. Accordingly, applicant has amended claim 5 to be in independent form, leaving claim 6 dependent on claim 5, amending claim 7 to be in independent form, and leaving claim 8 dependent on claim 7. Claims 5-8 are now in condition for allowance.

CONCLUSION

In view of the above amendments and remarks, applicant believes claims 1-3 and 5-17 are in condition for allowance, and applicant respectfully requests allowance of such claims. If any issues remain that may be expeditiously addressed in a telephone interview, the examiner is encouraged to telephone the undersigned at 515/558-0200.

Any fees or extensions of time believed to be due in connection with this amendment are enclosed with this amendment; however, consider this a request for any extension inadvertently omitted, and charge any additional fees to Deposit Account No. 50-2098.

Respectfully submitted,

Donald H. Zarley
Reg. No. 18,543
ZARLEY LAW FIRM, P.L.C
Capital Square
400 Locust Street, Suite 200
Des Moines, IA 50309-2350
Phone No. (515) 558-0200
Fax No. (515) 558-7790
Customer No. 34082
Attorneys of Record

- bjs -

VERSION WITH MARKINGS TO SHOW CHANGES MADE NOVEMBER 25, 2002

In the Specification:

The title beginning at page 1, line 1, has been amended as follows:

APPARATUS FOR DETECTING THE INTERNAL LIQUID LEVEL ~~DETECTOR SYSTEM~~ IN A VESSEL

In the Claims:

Claim 4 has been cancelled.

New claims 13-17 have been added.

Claims 1, 5, 7, 9, and 11 have been amended as follows:

1. (Amended) A system for detecting the level of liquid in a vessel, comprising:

a detector assembly including

a thermally conductive substrate,

~~an~~ a heater mounted on said substrate such that said heater is thermally coupled to the interior of the vessel, said heater being able to be actuated to add heat to the surface of the substrate thermally coupled to the interior of the vessel, and

a sensor mounted on said substrate in proximity to said heater such that discrete elevations of the interior of the vessel are thermally coupled to corresponding longitudinal portions of said sensor to generate an electrical signal defining a temperature signal, said correspondence being incrementally continuous such that the elevations corresponding to said portions of said sensor increase from one to the other of the ends of said sensor, said sensor being able to be actuated to detect the temperature in the vessel in proximity to the sensor indicative of the temperature detected by said

sensor, said sensor having a vertical dimension sufficiently large such that said temperature signal will vary in proportion to said longitudinal portion of said sensor thermally coupled to the liquid;

a processor electrically connected to said sensor for receiving said temperature signal after actuation of said heater, said processor being programmed to use said temperature signal to calculate the elevation of the upper surface of the liquid in the vessel thereby to generate an electrical signal defining an elevation signal indicative of the elevation of the liquid upper surface relative to the lower end of said sensor;

an interface electrically connected to said processor for receiving said elevation signal for use as the basis for communicating to the user the elevation of the liquid upper surface; and

a power supply electrically connected to said heater, sensor, processor, and interface, and wherein said sensor comprises a variable resistance means wherein the resistance to electrical conductivity of said sensor varies in proportion to the temperature detected by it, said temperature signal being of a magnitude proportional to the magnitude of the resistance, said programming of said processor comprising using said temperature signal to measure said resistance of said sensor, said programming further comprising using said resistance to calculate the elevation of the upper surface of the liquid.

5\. (Amended) ~~A system as set forth in claim 4,~~ A system for detecting the level of liquid in a vessel, comprising:

a detector assembly including

a thermally conductive substrate,

a heater mounted on said substrate such that said heater is thermally coupled to the interior of the vessel, said heater being able to be actuated to add heat to the surface of the substrate thermally coupled to the interior of the vessel, and

a sensor mounted on said substrate in proximity to said heater such that discrete elevations of the interior of the vessel are thermally coupled to corresponding longitudinal portions of said sensor to generate an electrical signal defining a temperature signal, said correspondence being incrementally continuous such that the elevations corresponding to said portions of said sensor increase from one to the other of the ends of said sensor, said sensor being able to be actuated to detect the temperature in the vessel in proximity to the sensor indicative of the temperature detected by said sensor, said sensor having a vertical dimension sufficiently large such that said temperature signal will vary in proportion to said longitudinal portion of said sensor thermally coupled to the liquid;

a processor electrically connected to said sensor for receiving said temperature signal after actuation of said heater, said processor being programmed to use said temperature signal to calculate the elevation of the upper surface of the liquid in the vessel thereby to generate an electrical signal defining an elevation signal indicative of the elevation of the liquid upper surface relative to the lower end of said sensor;

an interface electrically connected to said processor for receiving said elevation signal for use as the basis for

communicating to the user the elevation of the liquid upper surface; and

a power supply electrically connected to said heater, sensor, processor, and interface, and wherein said sensor comprises a potentiometer wherein the resistance to electrical conductivity of said sensor varies in proportion to the temperature detected by it, said temperature signal being equal to said resistance, said programming of said processor comprising using said temperature signal to measure said resistance of said sensor, said programming further comprising using said resistance to calculate the elevation of the liquid upper surface,

wherein said sensor comprises a potentiometer wherein the resistance to electrical conductivity of said sensor varies in proportion to the temperature detected by it, said temperature signal being equal to said resistance, said programming of said processor comprising using said temperature signal to measure said resistance of said sensor, said programming further comprising using said resistance to calculate the elevation of the liquid upper surface,

wherein said sensor is defined by an intermediate sensor, said system further comprising: an upper sensor mounted on said substrate adjacent to the upper end of said intermediate sensor; and a lower sensor adjacent to the lower end of said intermediate sensor, said upper and lower sensors being thermally coupled to the interior of the vessel to detect the respective temperatures therein in proximity to said upper and lower sensors, said upper and lower sensors being able to be actuated to produce respective electrical signals defining temperature

signals indicative of the respective temperatures detected by them, said upper and lower sensors each comprising a potentiometer wherein the resistance to electrical conductivity of each of said upper and lower sensors varies in proportion to the respective temperatures detected by them, said temperature signals of said upper and lower sensors being equal to said respective resistance values thereof, said processor being further programmed to calculate the distance between said lower sensor and the liquid upper surface according to the following equation:

$$l = \frac{R_i - R_{vp}}{R_{lq} - R_{vp}}$$

where l = longitudinal fraction of said intermediate sensor below said liquid upper surface;

R_i = resistance of said intermediate sensor;

R_{vp} = resistance of said upper sensor when exposed to vapor only; and

R_{lq} = resistance of said lower sensor when exposed to liquid only,

said processor being further programmed to calculate the vertical component of "l" for use as the basis for said generation of said elevation signal.

7. (Amended) ~~A system as set forth in claim 4,~~ A system for detecting the level of liquid in a vessel, comprising:

a detector assembly including

a thermally conductive substrate,

a heater mounted on said substrate such that said heater is thermally coupled to the interior of the vessel, said heater being able to be actuated to add heat to the surface of the substrate thermally coupled to the interior of the vessel, and

a sensor mounted on said substrate in proximity to said heater such that discrete elevations of the interior of the vessel are thermally coupled to corresponding longitudinal portions of said sensor to generate an electrical signal defining a temperature signal, said correspondence being incrementally continuous such that the elevations corresponding to said portions of said sensor increase from one to the other of the ends of said sensor, said sensor being able to be actuated to detect the temperature in the vessel in proximity to the sensor indicative of the temperature detected by said sensor, said sensor having a vertical dimension sufficiently large such that said temperature signal will vary in proportion to said longitudinal portion of said sensor thermally coupled to the liquid;

a processor electrically connected to said sensor for receiving said temperature signal after actuation of said heater, said processor being programmed to use said temperature signal to calculate the elevation of the upper surface of the liquid in the vessel thereby to generate an electrical signal defining an elevation signal indicative of the elevation of the liquid upper surface relative to the lower end of said sensor;

an interface electrically connected to said processor for receiving said elevation signal for use as the basis for communicating to the user the elevation of the liquid upper surface;

a power supply electrically connected to said heater, sensor, processor, and interface, and wherein said sensor comprises a potentiometer wherein the resistance to electrical conductivity of said sensor varies in proportion to the temperature detected by it, said

temperature signal being equal to said resistance, said programming of said processor comprising using said temperature signal to measure said resistance of said sensor, said programming further comprising using said resistance to calculate the elevation of the liquid upper surface,

wherein said sensor comprises a potentiometer wherein the resistance to electrical conductivity of said sensor varies in proportion to the temperature detected by it, said temperature signal being equal to said resistance, said programming of said processor comprising using said temperature signal to measure said resistance of said sensor, said programming further comprising using said resistance to calculate the elevation of the liquid upper surface,

wherein said sensor is defined by an intermediate sensor, said system further comprising: an upper sensor mounted on said substrate adjacent to the upper end of said intermediate sensor; and a lower sensor adjacent to the lower end of said intermediate sensor, said upper and lower sensors being thermally coupled to the interior of the vessel to detect the respective temperatures therein in proximity to said upper and lower sensors, said upper and lower sensors being able to be actuated to produce respective electrical signals defining temperature signals indicative of the respective temperatures detected by them, said upper and lower sensors each comprising a potentiometer wherein the resistance to electrical conductivity of each of said upper and lower sensors varies in proportion to the respective temperatures detected by them, said temperature signals of said upper and lower sensors being equal to said

respective resistance values thereof, said processor being further programmed to calculate the distance between said lower sensor and the liquid upper surface according to the following equation:

$$l = \frac{R_i - R_{vp}}{R_{lq'} - R_{vp'}}$$

Where l = number of increments between a lower end of said intermediate sensor and the liquid upper surface;

L = total number of increments between an upper end and said lower end of said intermediate sensor (any number of increments are possible, higher number increases resolution of calculation and the actual count is arbitrary and determined only by resolution requirements);

R_i = resistance of said intermediate sensor;

R_{vp} = resistance of said upper sensor without scaling;

$R_{vp'}$ = resistance of said upper sensor at the observed temperature when exposed to vapor only, scaled by dividing by the total number of increments; and

$R_{lq'}$ = resistance of said lower sensor at the observed temperature when exposed to liquid only, scaled by dividing by the total number of increments;

said processor being further programmed to calculate the vertical component of "l" for use as the basis for said generation of said elevation signal.

9. (Amended) A system as set forth in claim ~~4~~ 1, wherein said heater is constituted by said sensor.

11. (Amended) A system for detecting the level of liquid in a vessel, comprising:

a detector assembly including a thermally conductive substrate,

a heater mounted on said substrate such that said heater is thermally coupled to the interior of the vessel, said heater being able to be actuated to add heat to the surface of the substrate thermally coupled to the interior of the vessel, and

upper, intermediate and lower sensors mounted on said substrate in proximity to said heater, said upper sensor being at a higher elevation relative to said lower sensor, said intermediate sensor being at an elevation between said upper and lower sensors, said upper and lower sensors being thermally coupled to the interior of the vessel to detect the temperature therein in proximity to said upper and lower sensors, said upper and lower sensors being able to be actuated to generate respective electrical signals each defining a temperature signal indicative of said temperatures detected by said upper and lower sensors, said intermediate sensor being mounted on said substrate such that discrete elevations of the interior of the vessel are thermally coupled to corresponding longitudinal portions of said intermediate sensor to detect the temperature in the vessel in proximity to the sensor, said correspondence being incrementally continuous such that the elevations corresponding to said portions of said intermediate sensor increase from one to the other of the ends of said intermediate sensor, said intermediate sensor being able to be actuated to generate an electrical signal defining a temperature signal indicative of the temperature detected by said intermediate sensor, said intermediate sensor having a vertical dimension sufficiently large such that said temperature signal will vary in proportion to said

longitudinal portion of said intermediate sensor thermally coupled to the liquid;

a processor electrically connected to each of said sensors for receiving said temperature signals after actuation of said heater, said processor being programmed to use said temperature signals to calculate the elevation of the upper surface of the liquid in the vessel thereby to generate an electrical signal defining an elevation signal indicative of the elevation of the liquid upper surface;

an interface electrically connected to said processor for receiving said elevation signal for use as the basis for communicating to the user the elevation of the liquid upper surface; and

a power supply electrically connected to said heater, intermediate sensor, lower sensor, upper sensor, processor, and interface, and

wherein said sensor comprises a potentiometer wherein the resistance to electrical conductivity of said sensor varies in proportion to the temperature detected by it, said temperature signal being equal to said resistance, said programming of said processor comprising using said temperature signal to measure said resistance of said sensor, said programming further comprising using said resistance to calculate the elevation of the liquid upper surface.